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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/720,962	11/24/2003	Stuart Stephen Papworth Parkin	ARC920030058US1	5214

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EXAMINER	
NGUYEN, JOSEPH H	

ART UNIT	PAPER NUMBER
2815	

DATE MAILED: 04/29/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

SM

Office Action Summary	Application No.	Applicant(s)	
	10/720,962	PARKIN ET AL.	
	Examiner	Art Unit	
	Joseph Nguyen	2815	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *25 March 2005*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-50* is/are pending in the application.

4a) Of the above claim(s) *36-50* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-35* is/are rejected.

7)☒ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *24 November 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date 11/24/03
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

Applicant's election without traverse of claims 1-35 in the reply filed on 3/25/2005 is acknowledged.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1-7, 10-16, 22-35 are rejected under 35 U.S.C. 103(a) as being unpatentable over Odagawa et al. (US 6,436,526) in view of A.R Ferchmin et al. (disclosed on page 13, lines 3-7 of the instant application).

Regarding claim 1, Odagawa et al. discloses on figure 8A a magnetic tunnel element comprising a first layer 210 (col. 22, lines 25-26); an amorphous tunnel barrier layer 120 (the tunnel barrier layer formed of an oxide of Al which is amorphous in col. 25, lines 10-11); and an interface layer 220 between and in proximity with the first layer and the tunnel barrier layer, the interface layer being formed from at least one material selected from the group consisting of ferromagnetic material (col. 22, lines 35-39).

Note that the interface layer is formed of Co-Fe alloy (col. 22, lines 35-39) which is the same material being used in the instant application (page 5, lines 19-21 of the

instant application). Therefore, the interface layer material is inherently crystalline when it is in isolation from both the first layer and the tunnel barrier layer.

Further, Odagawa et al. teaches that the first layer 210 is formed of CoFeB (col. 22, lines 25-26) but does not teach the atomic percent of B is added to CoFe to make this alloy amorphous. However, applicant admitted that A.R Ferchmin et al. teaches crystalline Co-Fe becomes amorphous when B is added to this alloy in the range of 10-25 atomic percent (page 13, lines 3-7 of the instant application).

In view of such teaching, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Odagawa et al. by adding B in the range of 10-25 atomic percent to Co-Fe to make this alloy amorphous for the purpose of increasing current flow through the interface in a magnetic tunnel element.

Regarding claim 2, A.R Ferchmin et al. teaches that the first layer is formed from at least one material selected from the group consisting of amorphous ferromagnetic materials (page 13, lines 3-7 of the instant application).

Regarding claim 3, Odagawa et al. discloses on figure 8A a second layer 110 in contact with the tunnel barrier layer 120 and including at least one material selected from the group consisting of ferromagnetic material (col. 17, lines 7-9). Since layer 110 contains Fe, it is ferromagnetic.

Regarding claims 4-6, since Odagawa et al. and A.R Ferchmin et al. together teach a similar structure and material as claimed, it is inherent characteristics the magnetic tunnel element of Odagawa et al. and A.R Ferchmin et al. has a tunneling magnetoresistance (TMR) greater than 50%, 60% and 65%.

Regarding claim 7, the claim language is merely functional language. The interface layer 220 constitutes a similar structure and material as the claimed interface layer and therefore functions in a same manner.

Regarding claim 10, Odagawa et al. discloses on figure 8A the interface layer includes at least a Fe containing alloy (col. 22, lines 35-39).

Regarding claim 11, Odagawa et al. discloses on figure 8A the Fe containing alloy includes Co (col. 22, lines 47-49).

Regarding claim 12, Odagawa et al. teaches that the CoFe alloy contains between about 10 atomic percent and 95 atomic percent Fe. Odagawa et al. teaches that atomic percent Fe is 0.0 and 50 (col. 22, lines 37-39), which has its upper limit in the claimed range.

Regarding claim 13, Odagawa et al. teaches that the Fe containing alloy includes Co (col. 22, lines 37-39).

Regarding claim 14, Odagawa et al. teaches that the Fe containing alloy is formed from Fe and at least one of Co and Ni (col. 22, lines 37-39).

Regarding claim 15, Odagawa et al. discloses on figure 8A the tunnel barrier layer 120 includes an oxide of Al (col. 25, lines 10-11).

Regarding claim 16, Odagawa et al. discloses on figure 8A the first layer 210 includes an alloy of Co, Fe and B (col. 22, lines 25-26).

Regarding claim 22, Odagawa et al. teaches that the thickness of the interface layer is less than 30A (col. 22, lines 43-44).

Regarding claim 23, Odagawa et al. discloses on figure 8A the thickness of the interface layer is less than 20A (col. 22, lines 43-44).

Regarding claim 24, Odagawa et al. teaches that the thickness of the interface layer is so thin (less than 12A in col. 22, lines 43-44). Therefore, when in contact with the tunnel barrier layer and the first layer, the interface layer will become amorphous in the same manner as taught by applicant (page 20, lines 19-25 of the instant application).

Regarding claim 25, Odagawa et al. discloses on figure 8A a magnetic tunnel element comprising a first layer 210, an amorphous tunnel barrier layer 120 (col. 25, lines 10-11); and an interface layer 220 being formed from at least one material selected from the group consisting of ferromagnetic materials wherein the interface layer material is crystalline when it is in isolation from both the first layer and the tunnel barrier layer (see rejection of claim 1 above), the thickness of the interface being selected so that the interface layer is not crystalline (see rejection of claim 24 above). Further, A.R Ferchmin et al. teaches that the first layer is formed from amorphous material (see rejection of claim 1 above).

Regarding claim 26, A.R Ferchmin et al. teaches that the first layer is formed from at least one material selected from the group consisting of amorphous ferromagnetic materials.

Regarding claim 27, Odagawa et al. discloses on figure 6B a first plurality of conductive lines 142, 143; a second plurality of conductive lines 171 overlapping the first plurality of conductive lines at a plurality of intersecting regions 1001; and a plurality

of nonvolatile memory cells 1001 formed at respective intersecting regions 1001, at least one nonvolatile memory cell including a magnetic tunnel element comprising the structure as described in rejection of claims 1 and 7. See rejection of claims 1 and 7 above.

Regarding claim 28, Odagawa et al. teaches that the first layer is formed from at least one material selected from the group consisting of amorphous ferromagnetic materials (col. 22, lines 25-26).

Regarding claim 29, Odagawa et al. discloses on figure 8A a second layer 110 in contact with the tunnel barrier layer 120 and including at least one material selected from the group consisting of ferromagnetic material (col. 17, lines 7-9). Since layer 110 contains Fe, it is ferromagnetic.

Regarding claims 30-32, since Odagawa et al. and A.R Ferchmin et al. together teach a similar structure and material as claimed, it is inherent characteristics the magnetic tunnel element of Odagawa et al. and A.R Ferchmin et al. has a tunneling magnetoresistance (TMR) greater than 50%, 60% and 65%.

Regarding claim 33, Odagawa et al. teaches that the thickness of the interface layer is less than 30A (col. 22, lines 43-44).

Regarding claim 34, Odagawa et al. discloses on figure 8A the thickness of the interface layer is less than 20A (col. 22, lines 43-44).

Regarding claim 35, Odagawa et al. teaches that the thickness of the interface layer is so thin (less than 12A in col. 22, lines 43-44). Therefore, when in contact with the tunnel barrier layer and the first layer, the interface layer will become amorphous in

the same manner as taught by applicant (page 20, lines 19-25 of the instant application).

Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Odagawa et al. and A.R Ferchmin et al. and further in view of Parkin.

Regarding claim 8, Odagawa et al ad A.R Ferchmin et al. together teach all the structure set forth in the claimed invention except a metal containing layer in contact with the tunnel barrier layer and a semiconductor layer in contact with the first layer. However, Parkin discloses on figure 5 a metal containing layer 150 in contact with the tunnel barrier layer (via conductive layer 132) and a semiconductor layer 114 in contact with the first layer 117. In view of such teaching, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Odagawa et al ad A.R Ferchmin et al. by having a metal containing layer in contact with the tunnel barrier layer and a semiconductor layer in contact with the first layer for the purpose of obtaining high spin filtering efficiency of a magnetic tunnel element.

Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over Odagawa et al. and A.R Ferchmin et al. and further in view of Onodera et al.

Regarding claim 9, Odagawa et al. and A.R Ferchmin et al. together disclose substantially all the structure set forth in the claimed invention except a semiconductor material layer in proximity with the tunnel barrier layer. Odagawa et al. teaches on figure 8A the layer 110 in proximity with the tunnel barrier layer 220, but the material of layer

110 is Fe compound (col. 17, lines 5-10), not semiconductor. However, Onodera et al. teaches that Fe and Si (semiconductor) can be alternatively employed (para [0089], lines 1-5). In view of such teaching, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Odagawa et al. and A.R Ferchmin et al. by replacing Fe with Si (semiconductor) to form a semiconductor material layer in proximity with the tunnel barrier layer for the purpose of providing a specific application or design in a magnetic tunnel element.

Claims 17-18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Odagawa et al. and A.R Ferchmin et al.

Regarding claim 17, Odagawa et al. teaches that the first layer 210 is CoFeB (col. 22, lines 25-26). Odagawa et al. does not teach $(Co_7 Fe_{30})_{100-x} B_x$. However, it would have been obvious to one having ordinary skill in the art at the time of the invention was made to modify Odagawa et al. and A.R Ferchmin et al by having $(Co_7 Fe_{30})_{100-x} B_x$ for the purpose of increasing the capacity of the magnetic tunnel element, since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

Regarding claim 18, Odagawa et al. and A.R Ferchmin et al do not teach the value of X between about 15 and 20. However, it would have been obvious to one having ordinary skill in the art at the time of the invention was made to modify Odagawa et al. and A.R Ferchmin et al by having the value of X between about 15 and 20 for the

purpose of increasing the capacity of the magnetic tunnel element, since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

Claims 19-21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Odagawa et al. and A.R Ferchmin et al. and further in view of Saito et al.

Regarding claim 19, Odagawa et al. teaches that the first layer is the alloy of Co, Fe, B (col. 22, lines 25-26). Odagawa et al. does not teach the first layer is the alloy of Co, Fe, X and Y wherein in X and Y are independent and chosen from the group consisting of B, Hf, Zr, C, Be, Si, Ge, P and Al. However, Saito et al. teaches that the first layer is the alloy of Co, Fe, Si and B (col. 16, lines 25-44, Table 1). In view of such teaching, it would have been obvious to one of ordinary skill in the art the time the invention was made to modify Odagawa et al. and A.R Ferchmin et al. by having the first layer being the alloy of Co, Fe, Si and B for the purpose of reducing the writing power consumption in the magnetic memory as taught by Saito et al (col. 16, lines 50-51).

Regarding claim 20, when crystalline Co-Fe is added with a certain amount of B and Hf, the alloy would be caused to be amorphous.

Regarding claim 21, Odagawa et al. teaches that the first layer is the alloy of Co, Fe and B (col. 22, lines 25-26). Odagawa et al. does not teach the first layer is the alloy of Co, Fe and Zr. However, Saito et al. teaches that the first layer is the alloy of Co, Fe and Zr (col. 9, lines 27-31). In view of such teaching, it would have been obvious to one

of ordinary skill in the art at the time the invention was made to modify Odagawa et al. and A.R Ferchmin et al. by having the first layer being the alloy of Co, Fe and Zr for the purpose of obtaining a small coercive force in a magnetic tunnel element as taught by Saito et al (col. 9, lines 35-36).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Joseph Nguyen whose telephone number is (571) 272-1734. The examiner can normally be reached on Monday-Friday, 7:30 am- 4:30 pm. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tom Thomas can be reached on (571) 272-1664. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306 for regular communications.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

JN
April 21, 2005

Tom Thomas
TOM THOMAS
SUPERVISORY PATENT EXAMINER